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INVESTIGATIONS OF MEDIUM WAVELENGTH MAGNETIC ANOMALIES IN THE EASTERN PACIFIC USING MAGSAT DATA

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(MAGSAT Investigators)

MAGSAT QUARTERLY REPORT (APRIL-JUNE 1982)

This report consists of a series of plots illustrating the inversion of MAGSAT scalar anomaly data and the production of scalar anomaly maps at constant altitude.

Plot # 1:

This plot is a contour map of the scalar magnetic field data input into the inversion routine. The data consist of a 40 degree square subset of the MAGSAT scalar anomaly data set. The MAGSAT scalar data set consists of 2 by 2 degree averages of scalar data taken during magnetically quiet times. Our subset therefore consists of 441 points arrayed on a 2 by 2 degree grid.

Plot # 2:

This plot is a contour map of the average MAGSAT altitude at the observation points. We see that in this area MAGSAT'S altitude ranged from a minimum of 390km. to a maximum of 440km. This variation in altitude prevents inversion of the data set directly via a two dimensional "earth filter" to arrive at crustal magnetizations and forces us to reduce to constant altitude first.

The first two plots represent one half of the input to the inversion routine. The second half of the input involves the parameters of the dipole array used to model the observed fields.

The dipoles are layed out in a grid below the observed data set and are located within the earth's crust and aligned with the earth's magnetic field at that location. The dipole moment is left to be determined by the inversion routine so as to minimize the difference between the observed field and the field as calculated from the dipole array. For demonstration purposes we have chosen a 16 by 16 dipole array with dipole spacing equal 2.667 degrees.

Plot # 3:

This plot is a contour map of the field produced by dipole array at each of the observation points. We notice that while most of the gross features of the field are reproduced, fine details are somewhat different.

Plot # 4:

This is a contour plot of the difference between observed and modelled data. We notice that even though the RMS is only .47nT we have regions where the difference exceeds thrice that value. Interestingly enough, this region seems to correspond to the largest gradient of altitude variation. This indicates that the input data set is not as smooth as Plot # 1 would have one imagine.

Plot # 5:

This is a contour plot of the dipole moments calculated by the inversion routine and used to produce plots 3 and 4 and the plots of scalar anomalous fields at constant altitude. As one increases the number of dipoles in the equivalent source array, the fit to the field continues to improve, however, the computer time required to

process the arrays increases rapidily. Furthermore, the physical reality of the solution is lost as the solution starts to oscillate producing adjacent dipoles moments of large positive and negative values. The point at which the fit is adequate and the solution is physically relevant is dependent on the smoothness of the input data set. For our 16 by 16 dipole array we see that oscillations are beginning to enter the picture in a band along latitude 5 N.

Plot # 6:

This is a plot of the scalar anomalous field at 380km. generated from the contoured dipole moments displayed in Plot Number 5.

Plot # 7:

This is a plot of the scalar anomalous field at 400km.

Plot # 8:

This is a plot of the scalar anomalous field at 420km.

Plot # 9:

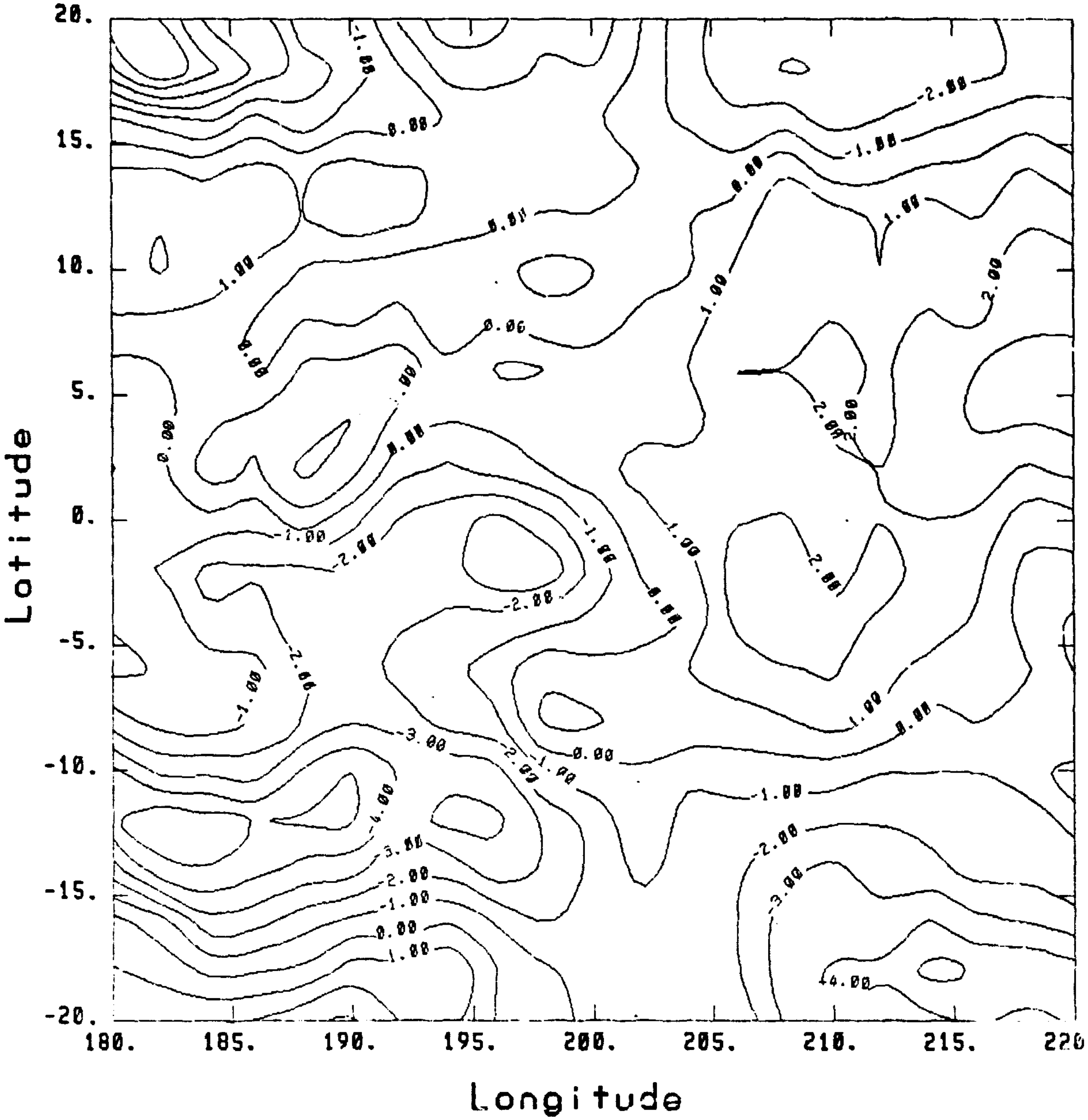
This is a plot of the scalar anomalous field at 440km.

Discussion

In figure 5, it can be seen that there is some evidence of instability of adjacent dipole moments, especially in the region of 5°N, 205°E. This may mean that the dipoles have been placed too close together. This is something that we are investigating further.

The last four plots are of especial interest because they show the sort of increase in resolution which is effected by lowering the altitude of the measurement point. Some anomalies are doubled in strength with only a 60km. lowering of the observation point.

MAGSAT Scalar Magnetic Field (nT)



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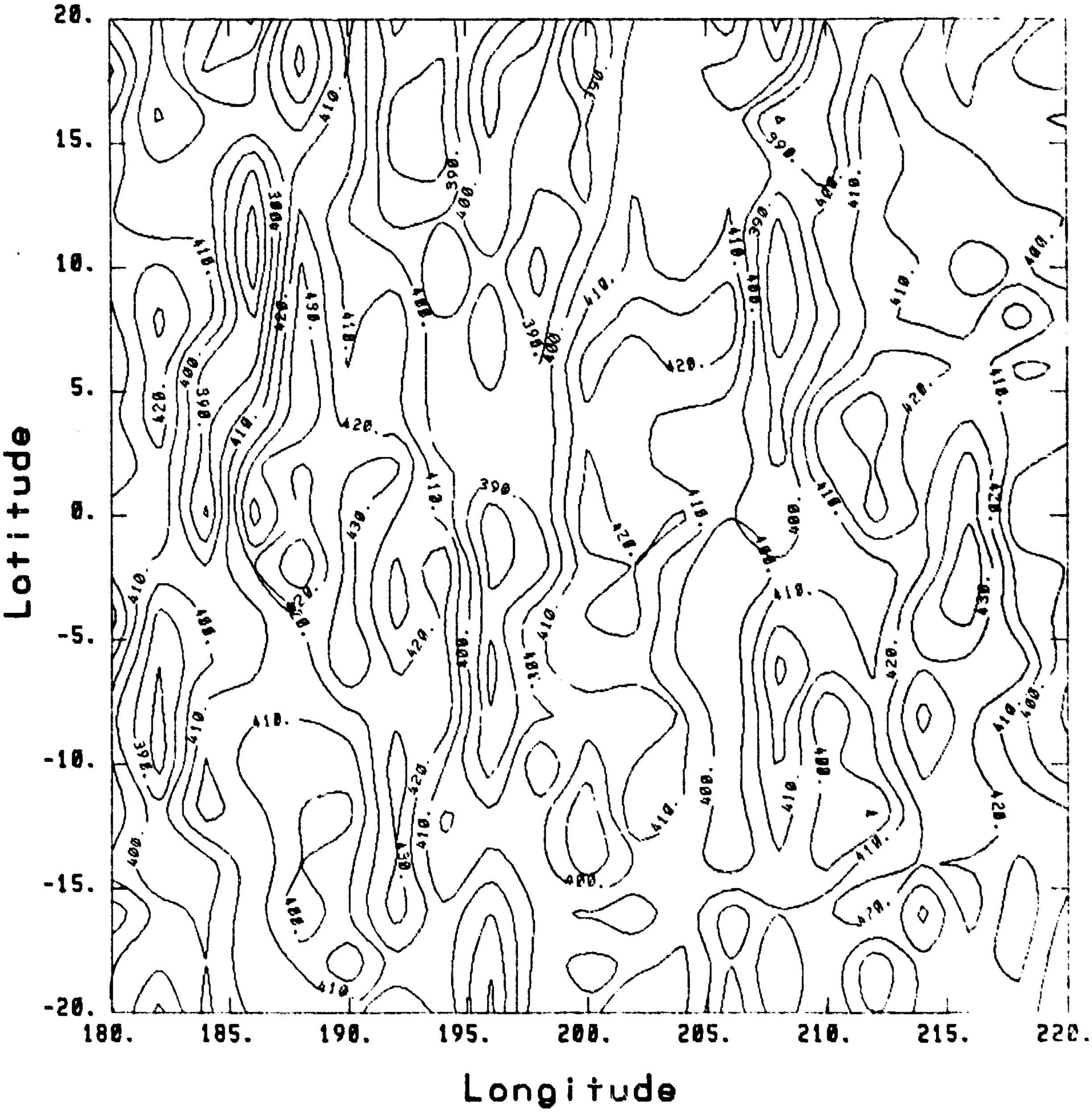
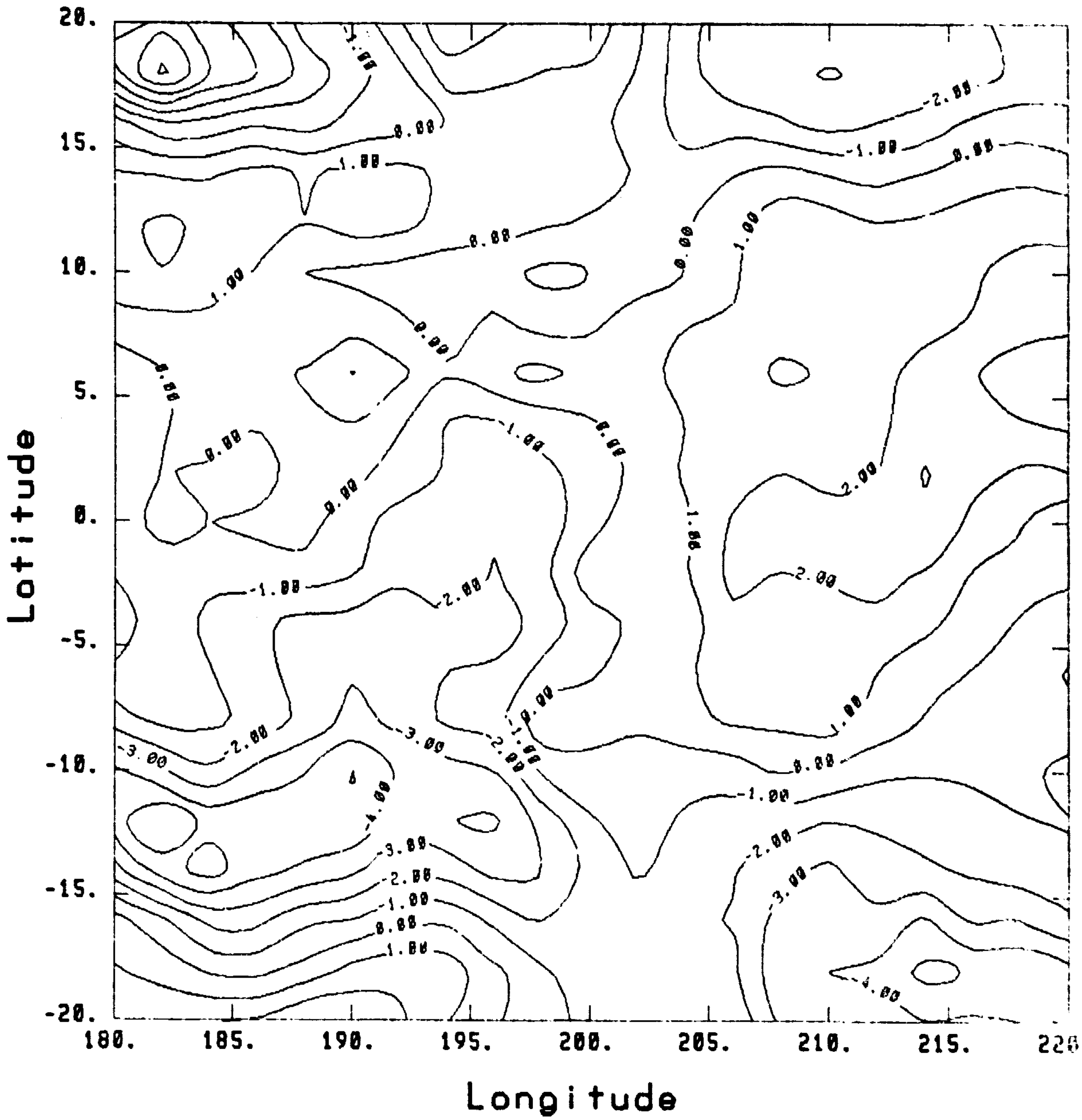
PLOT # 2

MAGSAT Altitude (Km)



PLOT # 3

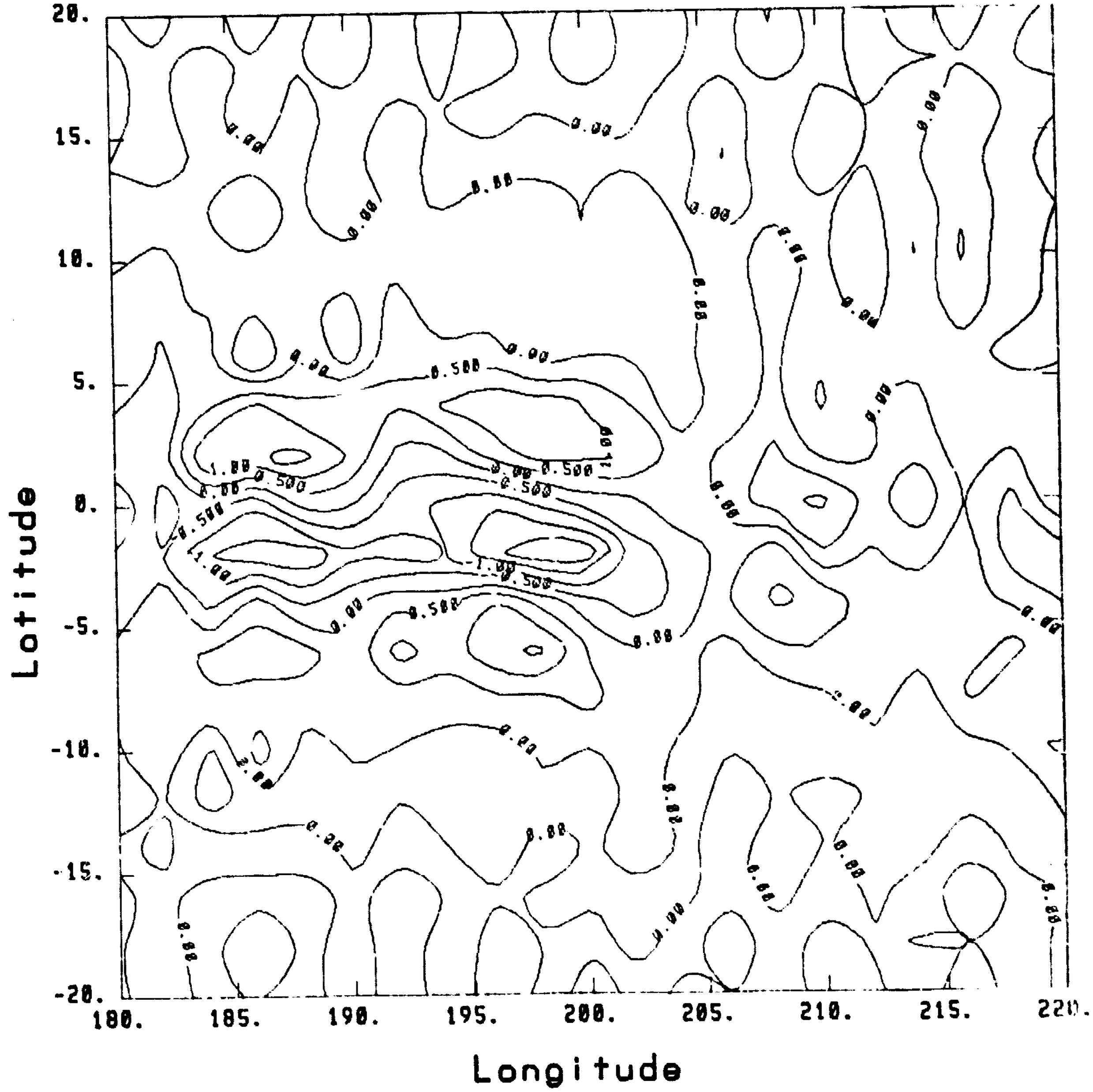
Modelled Scalar Magnetic Field (nT)



PLOT #4

Observed-Modelled Scalar Field (nT)

RMS = 0.4681



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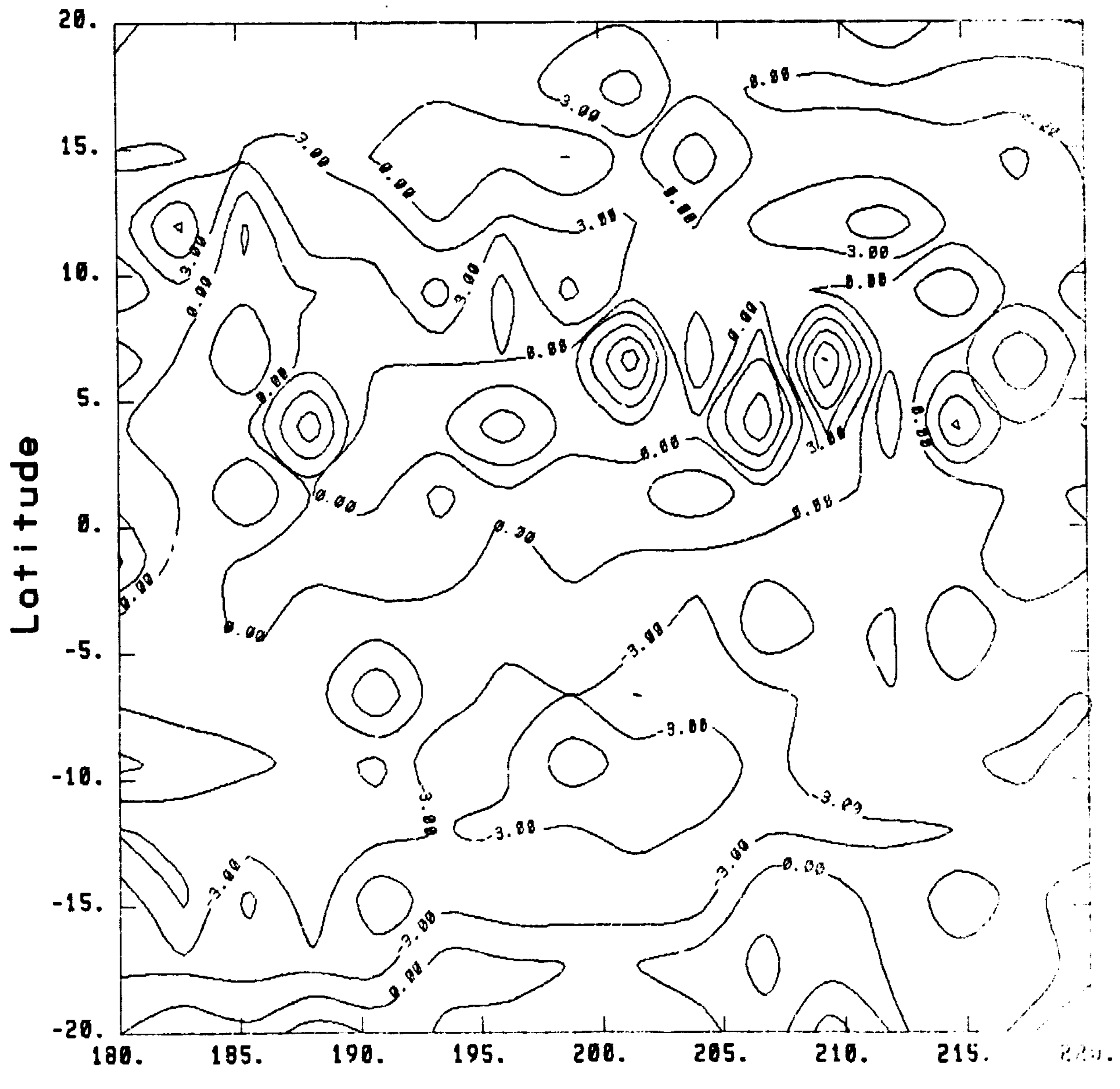
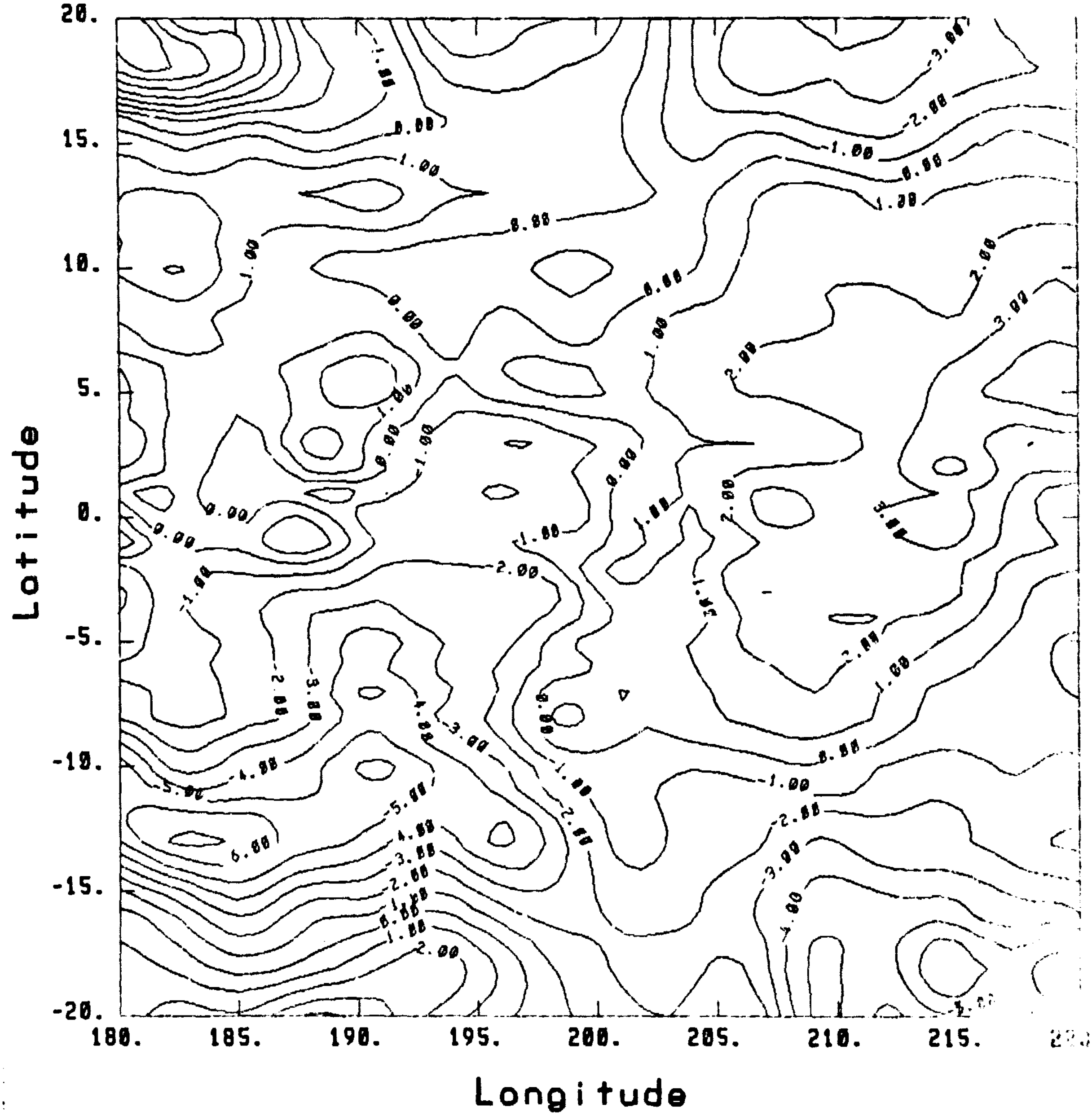
PLOT # 5

Modelled Dipole Moments (Amp-M*M)* 10^{14}



PLOT 6

Modelled Scalar Magnetic Field (nT)
Altitude (Km) = 380.0



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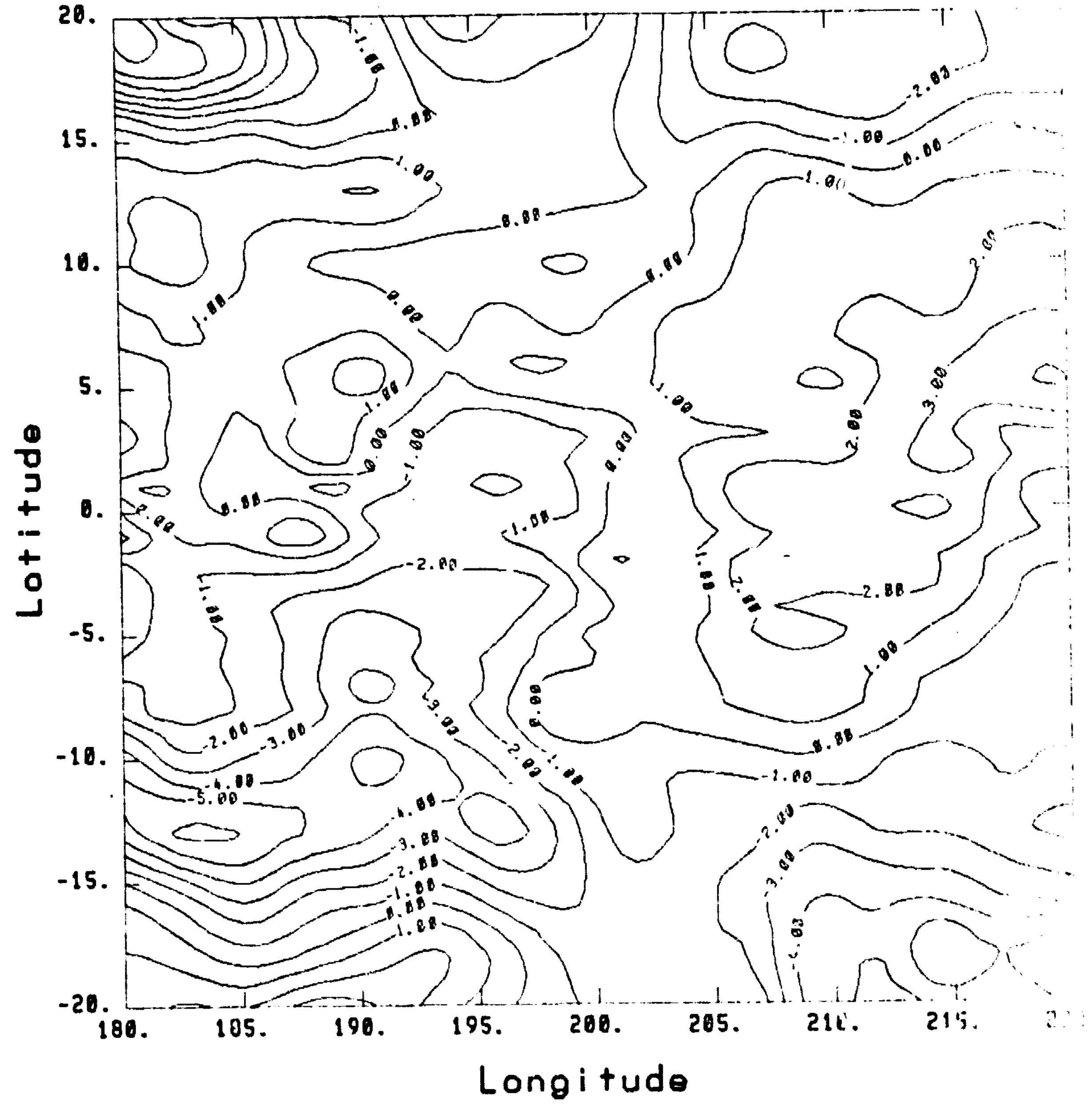
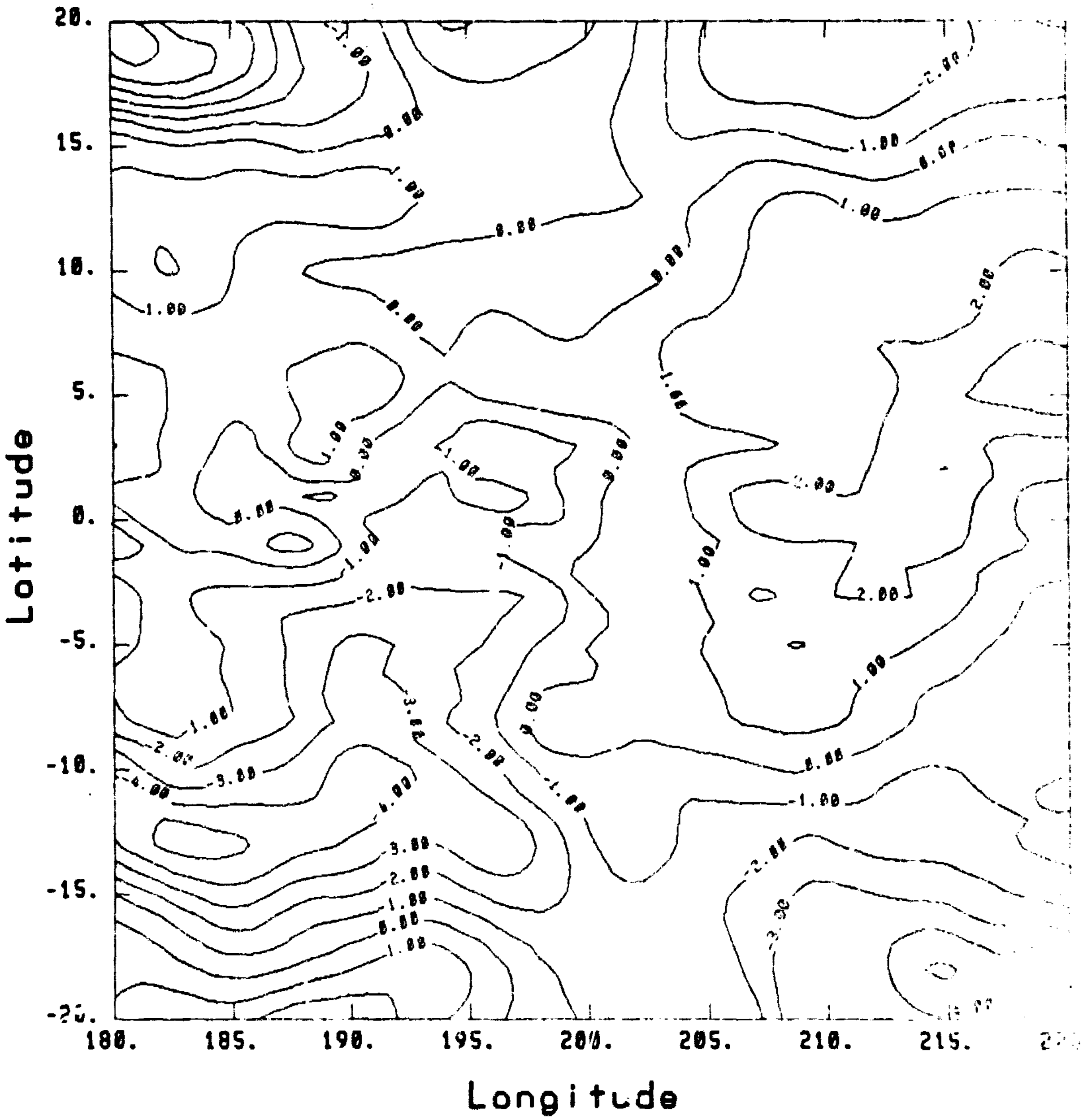
PLOT 7

Modelled Scaler Magnetic Field (nT)
Altitude (Km) = 400.0



PLOT 8

Modelled Scaler Magnetic Field (nT)
Altitude (Km) = 420.0



PLOT 9

Modelled Scaler Magnetic Field (nT)
Altitude (Km) = 440.0